VISUALISING DATA: EXPLORING DIGITAL METHODS FOR MAPPING AND VISUALISING INTERPRETATIONS OF CULTURAL HERITAGE SITES

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This paper considers how digital mapping technologies can create unique ways of visualising quantitative and qualitative data, using data collected during research into people's aesthetic responses to cultural heritage sites. This is then manipulated through GIS into various cartographic and visual representations to illustrate and communicate responses and possible trends. It demonstrates how enrolling the qualitative with the quantitative, the digital with the non-digital, can facilitate new and innovative ways of mapping and visualising different kinds of data. Consequently, it shows the potential and challenges of utilising such approaches to communicate knowledge within and beyond commercial, academic, and governmental contexts.

Key Words: Data Visualisation; GIS; Mapping; Digital Methods; Landscape Interpretation

1. Introduction

The aim of the paper is to consider the utilisation of digital mapping techniques, alongside quantitative and qualitative data sets, to explore how we can design new methods of data visualisation capable of representing and communicating people's experiences. To do so, the paper focuses on two key considerations. The first is to design research methods that can facilitate a data collection process, recording people's aesthetic and experiential responses to landscape in a format that allows the information to be digitised and manipulated through Geographical Information Systems (GIS). The second consideration involves devising new ways of presenting and communicating this qualitative information, specifically with data collected from an identified cultural heritage site, by using various cartographic representations. In this paper, the research focuses on Durham peninsula, Durham City UK, as the main data collection site. The peninsula itself is home to both Durham castle and cathedral, an area that was inscribed on the UNESCO World Heritage Site list in 1986 (Durham World Heritage Site, 2018).

Stemming from the designing of new methods and subsequent data representations, the paper will address two broader points for discussion. First, that there is potential to visualise relationships between people and place and show these connections by offering new angles for interpretation. Second, that there is a need to consider the bigger picture by developing an approach to communicating knowledge to audiences beyond academia; providing not just the tools and techniques to do so, but also the context to understand the methods. The paper is structured by starting with an introduction to the methodology, providing an outline of the mixed-methods approach and identifying the strategy used to collect the data in a strategic, systematic manner. It then discusses two different cartographic creations, a postcode map and a Likert map, indicating how they were designed and constructed, as well as their purpose. The paper then turns to acknowledge the challenges and potentials of the research, specifically limitations associated to the mixed-methods approach, including the design and collection of data, and the practicalities of implementing the methods within the investigation. This leads on to a discussion of the potential for utilising mixed-methods as an approach, arguing that for users to communicate knowledge to a wider, more diverse audience both inside and outside of academia, there is a growing need to consider the bigger picture, and engage better with data. To conclude, the paper reinforces that to visualise qualitative information alongside quantitative datasets, researchers need to better implement the research methods and the data so that they can produce more effective forms of data visualisation. This paper has done so by providing two examples of cartographic representation, the postcode map and Likert map, designed to communicate the relationships between people and place at specific cultural, heritage sites. Consequently, this paper argues that utilising these types of mixed-method approach can enable individuals to acquire a deeper understanding of various social processes, by using more creative forms of data visualisation.

2. The Methodology

2.1 A Mixed-Methods Approach

A mixed-methods approach is one in which both qualitative and quantitative research are used together as part of a research investigation; i.e. qualitative research aims to collect detail and description, providing explanations to understand various social processes, whereby quantitative

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research aims to measure and standardise phenomenon (Punch, 2005). For example, by visiting Durham Cathedral, a researcher could collect quantitative datasets about visitation statistics to specific heritage attractions; data that provides a measure of how many people have visited, per month, within the past year. The researcher may then collect qualitative data via interviews with people about their visits to the same heritage sites, using the approach to investigate the reasons for their visit, identifying if they have visited before, and find out their opinions and responses to the location.

The research discussed in this paper uses mixed-methods to collate a variety of information, using several data collection techniques, to collect both quantitative and qualitative detail (Punch, 2005; Bryman, 2016). Specifically, the paper was interested in collecting people's responses and perceptions of landscape, to understand how individuals may formulate relationships and place value onto specific cultural heritage sites. However, to do this, the methods had to facilitate the overall collection process so that the collected information could effectively be digitised and manipulated through GIS. They had a primary focus to quantify the qualitative, where qualitative information like the descriptions and opinions could be better collected, grouped and aggregated together for processing. To do this, questionnaires (or surveys) were used with a mixture of open and closed question to collect a set of data that can be measured quantitatively, such as; tick box selections, where the number of responses could be used to calculate a mode or an average; examples of continuum scales with a zero to five, like Likert Scales, where an average response could also be calculated from the responses. To be able to do this effectively, the methodology required a collection strategy.

2.2 Collection Strategy

A preliminary site visit to Durham peninsula allowed the researcher to become more familiar with the research location; getting to know the unique environment and setting, land use and the visual aesthetics, as well as identifying areas of varying participant availability. Doing so enables the researcher to plan for their data collection and investigate how best to associate the spatial aspect to link the primary data.

In this paper, the spatial link was made by systematically and strategically planning where best to collect the primary data around Durham, pinpointing a spatial reference that would link the data collected at each point to a map. These points were termed data collection points (DCPs) and identified areas that were most suitable for the data collection process; each one pinpointing key areas that would help to generate discussions with participants, providing the relevant detail, context and description (Schlossberg, *et al.* 2007). As observed in Figure 1, there are eight DCP points spread across Durham peninsula, replicating the methods at each;

Observed in the figure, each yellow triangle was an allocated DCP, each one set within its own unique

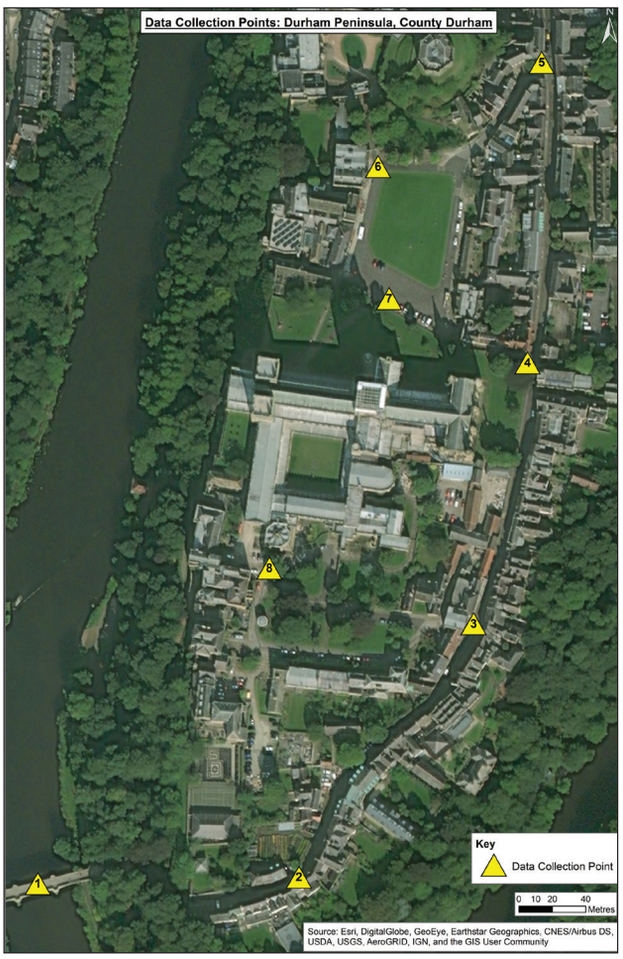

Figure 1: Data Collection Points: Durham Peninsula, County Durham

environment. For example; DCP1 in the bottom left-hand corner is located on Prebend's Bridge, on the outskirts of the peninsula and surrounded by riverside views. DCP5 on the other hand, is located the farther north at a junction, where the road splits and either takes traffic down towards the city centre, or foot passengers up towards the main Palace Green atop the peninsula. DCP8 is located at the back of the cathedral, in a secluded spot away from the main sites and attractions.

The pinpointing of the DCPs enabled a pilot test of the research methods, to ensure that each one was neither too close nor too far away from another at the research site, limiting the risk of recording the same data and duplicating the datasets. By using this collection strategy, rather than generalising the findings across the research site, these points can be used to observe more micro-scale patterns from within the datasets. Grouping the data at these specific points therefore allowed for information to be visualised geographically, to observe the trends from within the collected data and make comparisons between each of the DCPs.

2.3 Summary

The research is therefore about visualising and explaining the relationships and possible connections between people

and place. This has included investigating individuals' attitudes towards certain heritage sites, the reasons why people visit these places, the number of times they have done so, and so on. The remainder of this paper helps link two examples of cartographic representation, developed to investigate how people's perceptions of the Durham peninsula may vary across different parts of the World Heritage Site.

3. A Cartographic Creation #1

3.1 Postcode Maps

The first cartographic representation is what has been termed a Postcode Map. This began with the collection of secondary data from Edina Digimap (2018) to enable the researcher to impose primary, quantitative data on top of an ordnance survey map. The secondary data included ordnance survey maps and boundary data, which came in files known as shapefiles. Questionnaires were the main method of data collection for this representation. It involved asking open-ended questions including 'please provide the first half of your postcode…' to help the researcher understand how far the individual had travelled to visit Durham peninsula.

As part of the data collection techniques, only the first half of the participant's postcode was recorded to identify the areas individuals were from. Participants felt more comfortable disclosing this information if they were able to give a more generic response rather than a specific postal address, a tendency noted from the pilot testing of the methods. However, it meant that the Edina Digimap (2018) shapefiles that outlined each specific postcode area, required additional preparation. Each shapefile required the identification of a geographical centre to be able to calculate a direct, linear distance from the peninsula postcode (DH1), to the identified postcode areas. Using ArcGIS software, it was possible to quantify how many participants were from specific areas by looking for the same postcode halves. This then allowed the researcher to observe where most visitors had travelled from that day, plotting this information and using colour symbolisation to interpret the results, through the GIS software. The result, Figure 2 shows it is possible to interpret the scale at which individuals had travelled to be in Durham on that day.

3.2 The Purpose

The purpose of the Postcode Map is consequently to enable a visualisation of the travel distances that people have travelled, to visit specific heritage sites; i.e. Durham peninsula, Durham city. Figure 2 provides a visual representation of the scale of visitors that were drawn to coming to Durham City, but also prompts additional questions as to why; whether participants were there for a day out, a weekend breakaway, or because it is their place of residence. For example, the furthest direct linear distance calculated was 5075km, by an individual whom had travelled from Boston, USA, to visit Durham City. Within the UK, the furthest distance calculated was 377.3km

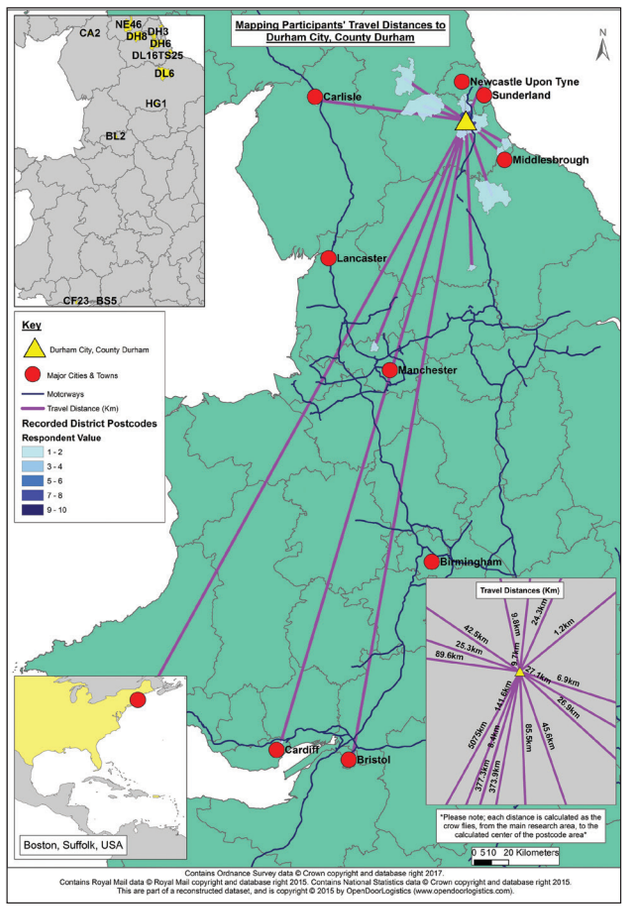

Figure 2: Mapping Participants' Travel Distances to Durham City, County Durham

from Cardiff, Wales, where one individual identified their postcode for this area. The shortest calculated distance was 1.2km from a central Durham postcode (DH1), whereby seven to eight individuals identified their postcodes from this area. However, there are limitations associated to these representations, the first being each direct linear representation does not consider the actual journeys made by each participant, so their travel distances may be far greater than those that have been plotted and calculated. Secondly, the calculation for the Durham postcode (DH1) is not entirely accurate, as some individuals may have lived on the peninsula itself. It means that the users of these maps must remember that because only the first half of each postcode was recorded, the geographical centre of each shapefile does not depict where everyone was from. Users must consider these as generalisations of responses by geographic area, to give an indication of the distances travelled by individuals to visit Durham peninsula.

Beyond the academic, there are other uses for a map like this. If the travel distance variables were plotted alongside the reasons for individuals' visits, it would be possible for places like Durham cathedral, to get a better understanding of their audience. Additionally, individual visits can be aggregated by social demographics (i.e. age, gender, etc.) to investigate queries like, what are the age ranges of individuals visiting the cathedral, and how far do

these people seem willing to travel? For example, it would be possible to plot visitor statistics for a twelve-month period against postcode location, to observe how the number of visitors to Durham may fluctuate over a year. Similarly, it would also be possible to identify where these people come from, to make sure that the main heritage attractions appeal to all and provides resources for all needs; such as exhibitions and their corresponding leaflets and guidebooks being produced in a variety of languages. Doing so means that cultural heritage sites like Durham cathedral, can better accommodate for their visitors, as well as push for promotional events and occasions by planning various agendas and exhibitions for the busiest times of the year; or alternatively, they can promote activities to pull in various audiences during more quieter periods. An example of this in 2013, where Durham cathedral arranged a fundraising programme with LEGO with an aim to raise money for a new exhibition (Durham Cathedral, 2018); adults and children alike could donate a pound to the cathedral and contribute to the building of a replica LEGO model. The new exhibition was planned to take place inside the cathedral itself, requiring the funds to renovate and design the new exhibition, based on the cathedral's history. As a result, these maps can be used to depict both travel distances and visitor statistics to a specific cultural heritage site, facilitating a better understanding of audiences (i.e. cathedral visitors) by providing visual representations of the relationship between people, space and place. More specifically, these maps function as additional supplementary detail, that can allow organisations, businesses and councils, to acquire more qualitative, in-depth knowledge about both local and visiting communities.

4. A Cartographic Creation #2

4.1 Likert Maps

The second map designed to present qualitative data also began with the collection of secondary data from Edina Digimap (2018), specifically ordnance survey base maps. These have been termed Likert Maps and are made by connecting qualitative information from the questionnaires to specific spatial references identified by the DCPs; these being the points which were identified in the collection strategy process (see section 2.2). Observing Figure 3 below, the scale of this map is much smaller than that of the postcode map above, i.e. it presents information from records solely within the peninsula area only. This means that aerial imagery could be sourced and applied to the cartographic representations to provide additional spatial context to the plotted results. As such, this imagery was sourced from the ArcGIS World Imagery database (ArcGIS, 2018), enabling users to view imagery down to a metre or better. As an additional visual aid, it allows users to interpret the relevant qualitative information more directly in relation to the surroundings and landscapes of each DCP.

Figure 3 was also constructed using questionnaires as the main method of data collection. As an 'objective measure' these were included in the design because of their capability to collect qualitative detail in a quantified manner, subsequently associated to specific genres or themes (Hartley, 2014). Participants were asked to indicate a response to a range of statements and phrases, using a Likert of one to five (Hartley, 2014); the number one indicated a response of strongly disagree, whilst the number five indicated strongly agree. Additionally, a zero 'opt out' option was also implemented into the design, so that those who did not feel comfortable answering the question, or the question simply did not apply to them, they could still provide a response and move on to the next. Once the questionnaires were completed, the data was then aggregated around the numerical rating scales to measure the attitudes and opinions towards the statements, consequently being used to calculate a representational value for each phrase (Harpe, 2015). Through descriptive statistical analysis, an average was then calculated for each set of statements asked of participants at each DCP, ready for manipulating through the GIS.

Figure 3 is a visual representation of a range of statements designed to test for evidence of 'place attachment' (Ram, *et al*. 2016), including;

a) I feel a personal connection to Durham city and its settings and services.
b) This landscape reminds me of past times and brings back memories.
c) This village/town/city is important to me because my family is originally from here.
d) After visiting Durham peninsula, I feel that the area means a lot to me.
e) I know Durham city really well.
f) I would like to spend more time here, if I could.

To do so, the shapefiles of squares were created in ArcMap and plotted in accordance to their associated DCP, each square representing one of the statements from the questionnaire; these being the coloured squares, placed at each data collection point. These shapes can not only be used to represent a specific statement, they can also include further information about each point. These details can be linked to each shape through attributes relating to specific files via a database, or more simply a table (i.e. land use and population statistics) (Jung, 2009). This table then contains all the information about a feature, which when corresponded to a determined symbology, results in a form of data visualisation. In this case, the average responses for each statement at each DCP was associated to the relevant shapefile, through the table of attribute. This information was then associated to a colour ramp, so that each numerical value was represented by a specific colour class. Processing the qualitative data through the GIS in this manner is termed a 'qualitative GIS' approach, where non-spatial qualitative data (i.e. perceptions and opinions) have been integrated through GIS to create new geographic representations that can be spatially analysed (Elwood and Cope, 2009:1).

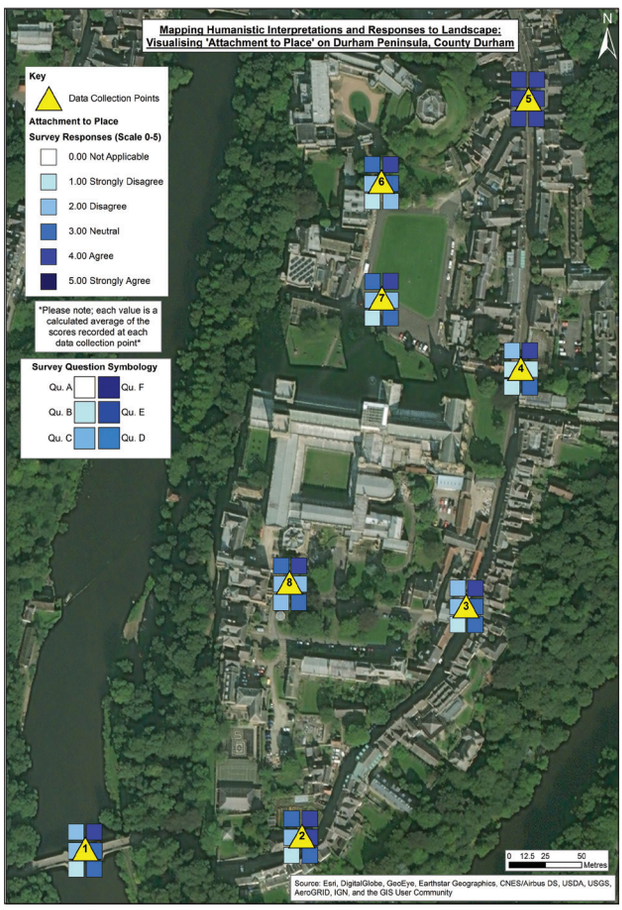

Figure 3: Mapping Humanistic Interpretations & Responses to Landscape; Visualising 'Attachment to Place' on Durham Peninsula, County Durham.

The map key shown in Figure 3 indicates that for responses which 'strongly disagreed' with any of the statements from A to F, these values were represented by the palest blue; responses which 'strongly agreed' with any of the statements were represented by the darkest blue. For the responses in between, these were identified along the colour ramp, with 'disagreed', 'neutral', and 'agree' each being allocated a different shade of blue. In other words, the more strongly a person agreed with a statement, the darker blue the colour symbology. However, where there was either no data provided, or no responses given, the value for zero 'not applicable', was allocated white. As observed in Figure 3, each of the six statements can now be viewed in correlation to where the information was recorded, and the average response value visualised in comparison to the other DCPs. To provide an example, statement A is the top left-hand square of a series of six plotted at each DCP. It is possible to compare each of these squares from all the data collection points, to interpret that evidently participants at DCP5 agreed that they felt a personal connection to Durham.

4.2 The Purpose

The purpose of the Likert Map is to enable a visualisation of people's opinions, regarding specific cultural heritage sites; i.e. Durham peninsula. They allow researchers to visualise potential relationships between people and place. Figure 3 enables users to visually compare qualitative detail, collected from a variety of points across the peninsula, in association to the spatial setting that information was collected in. So, in this example, the user can interpret that 'place attachment' was collectively more evident in the data collected at DCP5, rather than amongst the landmarks and monuments of Durham castle and cathedral, or the student accommodation blocks of South Bailey (Kyle, *et al.* 2004; Ram, *et al*. 2016).

Beyond the academic however, there are additional uses and purposes that a map like this can contribute to. For example, through being able to observe perceptions in this manner, councils, businesses and organisations could better understand the opinions of individuals in specific areas of towns and cities, to then be able to meet the community's needs and desires. For a redevelopment scheme in a town centre, it would be possible to integrate the opinions of both the public and visitors to pinpoint which areas need more focus than others. This could include areas that may need additional attention to help the community feel safer, deal with areas that may be more visually displeasing, and allow the planners to get a better understanding of the needs and demands of the community. As a result, these can be used to add further supplementary detail to a variety of projects when used as part of an integrative approach.

5. Challenges & Potential

5.1 Approach, Design & Collection

Researchers most commonly see the quantitative and qualitative as two very distinct realms, approaching each as a separate entity and almost reinforcing a 'dualism' of the two (Philip, 1998:262). Whilst this paper is not suggesting that the quantitative and qualitative are the same thing, it aims to demonstrate to researchers and other practitioners that there is a need to think beyond this division and bridge that divide. It is possible to use the benefits of both quantitative and qualitative methods, to strengthen the visualisation process (Elliot and Timulak, 2005; Aitken and Kwan, 2009).

It means that there is now a need for 'novel' methodological approaches (DeLyser and Sui, 2012:294) to create effective representations of information, capable of communicating geographical trends and patterns to all. In this paper, it has required creating new tools and techniques for visualising the bonds and connections that individuals form with their surroundings; i.e. sense of place and attachment to place (Kyle, *et al*. 2004; Ram, *et al*. 2016). Considering the analytical process, it requires moving 'towards a [more] grounded theory' approach, whereby the aim of the analysis is to 'tease out their negotiated meanings and situated knowledges' (Elwood and Cope, 2009:4) and present this information in effective and innovative ways. By doing so, it enables both the researcher and practitioner alike to ask and

answer questions such as; how do people interact within the spaces in our world? How do individuals perceive and experience their surroundings?

5.2 Practicalities

However, there are also more practical capabilities and potentials to consider and take advantage of. Computer coding practices can provide an increased level of detail and technological understanding of the data, but only if the individual has the skills to do so. In a team of analysts, visualisation designers, and so on, it is possible to further meet the needs of the data by recruiting individuals with the necessary skill set. When working independently, such as on research projects like the one discussed in this paper, this is not feasible. The researcher for this paper was not able to utilise coding practices and develop or use any form of code, due to not having the necessary skill set; having never been trained or shown how to do so. But this is not a be all and end all. This paper has shown that there are alternative methods for reaching the full potential of acquired datasets.

On the other hand, access could limit the designing and creating of visual methods; whether due to license restrictions, the availability of data sources, the resolution of imagery, and/or issues of incomplete datasets. These are not issues that can be fixed with a simple statement, however this paper has highlighted how these problems can be overcome and there are ways of dealing with a variety of restrictions and obstacles. In this case, as the paper itself stems from a PhD research investigation, the author has access to a wide variety of GIS data sources and tools available to use. However, this does not approach the capabilities of those outside of academic confines. For those who are not a part of bigger businesses and registered organisations, access to these data sources, resources and tools are restricted and expensive. Instead, to be able to utilise methods like those discussed, this information needs to be made available to all, and in doing so we have to consider, at what cost?

6.0 Discussion

6.1 The Potential

By considering this approach as a methodological tact (Elwood and Cope, 2009), and combining the qualitative and quantitative effectively, it is possible to consider this an integrative approach (Gregory, *et al*. 2009). By using qualitative GIS (Cope and Elwood, 2009), research investigations and their resulting methodologies can combine a variety of data types, to facilitate the visualisation of spatial patterns. Doing so strengthens and adds depth to the user's understanding of various geographical phenomenon, yet still provides a method of communicating new knowledges. It is a flexible practice that has the ability to 'fill gaps' in both research, and more practical applications (Elwood and Cope, 2009:5).

In using such an approach, it is possible to combine qualitative detail to quantitative data sets. Mapping specifically has allowed for this, with the above Figures 2 and 3 providing examples of how it is possible to combine a variety of data types. Consequently, mixed-methods can facilitate the data visualisation process (Pavlovskaya, 2009), contributing to geographical enquiry and providing a clear example of how it is possible to make the most out of mixed-methods approach. As such, these examples provide a level of connectivity, especially from a spatial context, to map the unmappable (Yeager and Steiger, 2013).

6.2 The Bigger Picture

Furthermore, there is a greater need to develop an approach that can communicate knowledge to everybody, not just those within academia; to do so in its entirety, not just providing a step-by-step guide. To do so requires being able to better engage with the 'big data' (Kwan, 2016:277), to be able to 'search, connect and analyse', and reveal the patterns and trends necessary for geographic enquiry (Ash, *et al*. 2016:29).

For example, take the qualitative GIS approach that has been in this research (Travis, 2015; Cope and Elwood, 2009), and think of it like a three-tiered cake. The information, detail and description that is gathered and collated in the data collection process is the bottom tier, the first, foundational level of data. The second layer represents the digitisation process of the data, followed by the manipulation and resulting analysis through GIS software; i.e. the transformation of the data into visual representations of trends and patterns. This is a smaller 'layer' due to the selective nature of choosing the variables for testing; such as attachment to place versus location. The third and final tier is the smallest, whereby the data used to communicate research mostly comes from the actual conclusions derived from the findings of the second tier. It is much smaller in layer because of the selective nature of the analytical and representational processing. However, the paper suggests that because this qualitative GIS is such a flexible approach, it is possible to think of these methods as not individual layers of cake, but as one construct. Doing so enables this integration of the methods into an effective and reflexive methodology, for researchers, cartographers, and other visual based individuals, to present a bigger picture.

7.0 Concluding Comments

7.1 Visualising the Qualitative and the Quantitative, Communicating the Research

In conclusion, this paper has provided evidence to suggest that there is potential to visualise the relationships between people and place, and it is possible to develop unique approaches of doing so. By using qualitative GIS as part of a mixed-methods approach, the paper has shown that it is possible collect qualitative detail in a quantifiable manner, linking the qualitative data to specific spatial references and points (Elwood and Cope, 2009). This has made it possible to integrate various forms of knowledge from

a variety of techniques, creating more novel methods of research that can then be used to design new forms of data visualisation (Cope and Elwood, 2009; Aitken and Kwan, 2009). Specifically, the two cartographic representations have been able to provide a visual format for users to observe qualitative information, in relation to the surrounding landscapes and spaces that the information was collected in. They provide additional context to provoke further questions for investigations, such as; what may have influenced the perceptions formulated by individuals? How do people place value upon specific heritage sites, and why?

However, to be able to communicate research in an effective manner, users alike must be able to engage with the data throughout the planning, collection, manipulation and analytical processes. Doing so ensures that the individual can fully understand their data, allowing them to ground themselves within the analysis by systematically pulling out the resulting trends and knowledges, to consider how to best to represent and visualise these stories and geographical patterns (Elwood and Cope, 2009). Quite alike the cake analogy used previously, these mixed-methodologies need to be considered as an integrative process of both data types, the research methods and overarching research questions, to make sure the resulting representations of data are effective in communicating findings and conclusions (Kwan, 2016; Travis, 2015; Cope and Elwood, 2009). This paper may have only provided two cartographic representations as examples of how to do so, but they are however indictive of the multiple ways we could communicate the relationships between people and place, at specific cultural heritage sites.

7.2 Further Thoughts

The aim of the paper was to demonstrate how a mixed-methods approach can facilitate new and innovative ways of mapping and visualising different kinds of data. Specifically, how these methods could be incorporated into a wider variety of research designs in geography, but additionally how these may be applied to other fields and disciplines. Researchers and practitioners alike can use both qualitative and quantitative research methods as part of an exploratory approach, reducing the dualism between the qualitative and quantitative realms of research, and strengthening the ability to communicate knowledge through data visualisation.

However, it is an ongoing, working progress. There are many different other ways and methods of presenting data and knowledge, and this paper has merely provided a hint of the potential to do so. But to be able to communicate knowledge effectively, users must be able to acknowledge the various stages to designing effective visualisation methods and consider the resulting representations as part of a bigger, wider picture. Raising questions like; what are they trying to show? How are they going to do it? Who is the intended audience? Why are they necessary? There is a greater need now for cartographers, researchers, practitioners alike, to sit down and discuss how else to approach using visualisation techniques, to communicate knowledges beyond the confines of the academic, and to the public sphere.

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Additionally, the project uses innovative applications of Geographical Information Systems (GIS) to capture and display such data, with the aim of devising a mixed-methods approach that can map interpretations and responses to heritage landscapes; concurrently developing tools and techniques to analyse and enable the visualisation of responses to landscape through forms of digital cartography.

More broadly, Isabel is interested in heritage geographies, critical GIS and cartographies, and data visualisation. She is also a founding committee member of the Digital Geographies Working Group, in association with the Royal Geographic Society (with IBG).